

IN THE SPECIFICATION:

Please make the following corrections, as shown in the paragraphs set forth below:

A1 [34] The Local ICE Management Program can receive instructions and configuration parameters either through a standalone (non-real-time) M&C channel or, optionally, through a real-time, interactive M&C channel. Real-time, interactive M&C channels are well known in the art and often use an in-band signaling channel (also known as an engineering service channel or "ESC") for exchange of M&C information. Typical ICE M&C configuration parameters include the start time and stop time of ICE mode of operation, HPA power level, time adjustments, transmit frequencies, receive frequencies and other parameters. Received ICE M&C configuration parameters are stored in NVRAM associated with the DSP on the DSP Board. Standalone management is more challenging, since instructions must be reduced to numbers that can be entered using a numeric keypad or even more basic user interfaces. The standalone version of the ICE M&C channel uses defined message formats, rigid syntax, and encryption to produce small sets of apparently random numbers that, when decrypted, are can be executed only by a given ICE Modem. The set of numbers can be faxed, ~~phone~~, phoned, mailed, telexed, telegraphed, emailed, etc., to a user. In the Inmarsat-B ICE MES Retrofit, the user enters the set of numbers contained in an ICE M&C message using the keypad of the ICE Modem or of the MCU telephone handset. The Local ICE Management Program decrypts the set of numbers to produce a set of configuration parameters, confirms the target of the configuration as the ICE Modem under the control of the DSP, and then stores the configuration information in NVRAM associated with the DSP. The DSP periodically queries the current configuration of the MCU and selects the appropriate configuration from NVRAM based on the ocean region setting for the MCU and the current date and time. The DSP also queries the current configuration of the ICE Modem and changes the configuration of the ICE Modem as needed to match the appropriately selected configuration stored in NVRAM.

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CONF [64] As shown in FIG. 2, the Inmarsat-B ICE MES Retrofit supplements the standard Inmarsat-B MES equipment with a second SCPC modem (the "ICE Modem" or "external satellite modem" or "second satellite modem") (201) configured with Viterbi error correction (e.g., rate 7/8 FEC) and concatenated Reed-Solomon error correction, a DSP Board (202),

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control signals and paths, and ICE M&C software and hardware. The ICE Modem normally used is an EFData SDM-300L-2 ("EFData 300L"), which supports various modulation methods, FEC rates, and Reed-Solomon error correction. The EFData 300L modem is manufactured by Comtech EFData, 2114 West 7th Street, Tempe, Arizona 85281 (www.efdata.com). The EFData 300L modem case contains a cavity in which a power supply or other equipment can be mounted. The DSP Board is normally board-mounted and inserted in this cavity. The EFData 300L modem software includes an application programming interface ("API") that permits parameters, such as modulation method and error correction methods, to be configured via a "remote control" asynchronous EIA-232 I/O port. The ICE M&C port type and I/O driver software on the DSP Board match the external data bus types and data rates with which the DSP interfaces. The M&C I/O ports on the DSP Board are usually EIA-232 async ports, but the M&C I/O port could be a universal serial bus port, EIA-1394, parallel port, or other type of port, depending on the ICE M&C channels used. In ICE embodiments using an EFData 300L as the ICE Modem, the DSP Board includes a multi-port Universal Asynchronous Receiver Transmitter ("UART") and UART software driver to provide an ICE M&C channel between the DSP and the ICE Modem. (The local M&C control paths and UART are described in more detail in the discussion of FIG. 8 below.) The remote control port (201) on the EFData 300L modem is connected by an internal cable to a first port on the UART (204) on the DSP-based computer embedded on the DSP Board (such computer is called an "Embedded DSP"). This async connectivity enables the Embedded DSP to configure and control the EFData 300L modem. The Inmarsat-B MES normally used with the ICE invention is the Nera Saturn Bm ("Saturn B"), manufactured by Nera ASA, Kokstadveien 23, Bergen, Norway (www.nera.no). The Saturn B software is available with an API that enables external control of the Saturn B HPA via a standard EIA-232 or data terminal equipment ("DTE I/O") port on the MCU. A second port (205) on the UART in the Embedded DSP is connected to the Saturn B DTE I/O port (206) to provide an ICE M&C channel between the DSP Board and the MCU. ICE M&C messages exchanged between the MCU and the DSP Board include messages reporting the status and configuration of the Saturn B and messages to control the transmit power level of the Saturn B HPA. The Saturn B API may also enable external use of the MCU display and telephone keypad so that user input and display output can be sent through the Saturn B DTE I/O port to the DSP. L-band modems and Inmarsat-B MESs of other manufacturers can be used so long as such

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equipment provides the APIs, I/O ports, and control capabilities that are described above and required by the ICE invention. Such APIs are specific to a given manufacturer's equipment, and the commands and parameters provided by the Local ICE Management Program are tailored to support each such API. A third port (207) on the UART is used for diagnostic purposes by connecting a local PC or an async M&C channel to the ICE Server via an external network. A fourth port (208) on the UART can be used to connect to an ESC card that, if installed in the ICE modem, multiplexes in the traffic path an ICE M&C channel to the ICE Server. When an ESC card is not installed in the ICE Modem, the fourth port on the UART can be used for other ICE M&C purposes, such as handover coordination in a redundant configuration of Inmarsat-B ICE MES Retrofits described below. The DSP also sets some status LEDs on the user interface displays of the ICE Modem and/or MCU and sets control leads (209, 210) for the entry and exit switches on the DSP Board. If additional control of local async devices is desired, such as when an ESC ICE M&C path, a redundant configuration of Inmarsat-B ICE MES Retrofits, and a dedicated diagnostic port are required, a UART with additional ports (e.g., a 6 port UART) may be used.

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[66] The Embedded DSP (220) executes a copy of the Local ICE Management Program that controls whether the ICE mode of operation can be activated. The Local ICE Management Program interfaces the DSP with the MCU, the ICE Modem, and certain components on the DSP Board. The output of the DSP Board is fed to the HPA in the RF terminal (216). The transmission path from the MCU and from the ICE Modem, through the DSP Board, to the RF terminal is two way (transmit and receive) except during ICE ON modes, when the standard modem transmit path is terminated in a dummy load (221). During ICE OFF modes, the ICE Modem has no transmit output. An Inmarsat-B ICE MES Retrofit can transmit and receive in either standard or ICE mode, but not both modes, at a given time.

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[73] FIG. 6 shows a state table that specifies under what MES conditions the Local ICE Management Program can acquire use of the ADE for ICE mode operations. The Local ICE Management Program controls the diplexer/switch and ICE Modem directly and the HPA through messages to the MCU. The Local ICE Management Program polls the MCU frequently to learn MES status. To ensure compliance with Inmarsat specifications, if the MCU detects an error condition in the MES (including the HPA), the MCU changes MES status messages from

“OK” to an error message. ICE ON mode can be invoked manually or according to configuration parameters (i.e., start and stop times) stored in NVRAM in the Embedded DSP.

The Local ICE Management Program also prevents an Inmarsat-B ICE MES Retrofit from entering or remaining in ICE ON mode unless the Inmarsat-B ICE MES Retrofit is currently receiving forward carrier (i.e., RF carrier from a LES to a given Inmarsat-B ICE MES Retrofit).

[79] The ICE Server application software comprises three principal components, an ICE Management Engine (816), an ICE Management Gateway (817), and a Key and Reporting Engine (818), ~~and a Resource Manager (819)~~. The ICE Server application software manages and controls the critical parameters of Inmarsat-B ICE MES Retrofits (and other ICE embodiments described below) through the use of an ICE M&C message type called an “encrypted configuration code” (“ECC”). Inmarsat-B ICE MES Retrofits and other ICE embodiments described below are hereafter collectively referred to as “ICE-enabled Terminals”. Each ECC (820) is addressed using an identification number unique to a given ICE-enabled Terminal. Only an ICE Management Engine (816) can generate ECCs. The ICE Management Engine generates and encrypts each ECC using an encryption algorithm, a seed key, and a Pseudo-Random Number (“PN”) code generator. The encryption algorithm, seed key and PN code generator method is known in the art, e.g., public key/private key infrastructure uses a similar method of an encryption algorithm, a seed key, and PN code generator. When the input to the encryption process is integers, the encrypted output can be integers formatted to meet the requirements of various ICE M&C channels (as an example, for a standalone ICE M&C channel using the front panel keypad of the EFDData 300L modem for entry of an ECC, numbers must use a “5.3” or “xxxxx.yyy” “dotted decimal” format.). A given ICE Server and all ICE embodiments controlled by the ICE Server use the same PN code generator method and rules. The PN code generator at a given ICE Server may be reconfigured from time to time via an encrypted message delivered through ICE M&C channels to ensure security of the ICE M&C channels. In FIG. 8, the ECCs (820) generated by the ICE Management Engine (816) are forwarded to the ICE Management Gateway (817) for delivery by stand-alone ICE M&C channels (803) to the specific ICE-enabled Terminal addressed in the ECC. In a stand-alone ICE M&C channel, the operator of the ICE-enabled Terminal in FIG. 8 enters an ECC through either the keypad (805) on the ICE Modem or the keypad (806) on the MCU handset. The Embedded DSP in the ICE-enabled

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Terminal collects the entered ECC through a local ICE M&C channel (normally carried on a local async M&C path (811) between the Embedded DSP and the MCU, or the local async M&C path (812) between the Embedded DSP and the ICE Modem, depending upon which keypad was used to enter the ECC).

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[87] As shown in FIG. 10, the ICE Server application software can be (and normally is) distributed over networked server computers and connected through server-side stand-alone or real-time ICE M&C channels (1001). When the ICE Server application software uses a distributed architecture, such as the architecture shown in FIG. 10, the server computer associated with a LES and that hosts the ICE Management Engine (1002) is called a "LES Server" (1003), and the server computer that hosts a copy of the ICE Management Gateway software (1004) at a NOC is called a "NOC Server" (1005). A NOC Server (1005) is associated only with the network operations of a given user of ICE Services. (A customer of ICE Services provided by a LESO that operates a NOC Server is called a "NOC Operator". A NOC Server runs a copy of the ICE Management Gateway software (1004) that is activated by a software key issued by the Key and Reporting Engine (1006) running on a LES Server. A plurality of NOC Servers may be implemented and associated via a server-side network (1001) with a given LES Server. An ICE Management Gateway (1007, 1004), whether it runs on a LES Server or on a NOC Server, is a software application that uses ICE M&C channels to interact with one or more LES Servers, ICE-enabled Terminals, and other ICE Management System components described below. When an ICE Management Gateway (1002) runs on a NOC Server (1005), the NOC Operator manages the delivery of ICE M&C messages to ICE-enabled Terminals through an ICE M&C channel (standalone and/or interactive).

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[91] As shown in FIG. 13, the ICE Management Engine ("IME") (1301) software application comprises the IME Kernel (1302), two interprocess interfaces (LES Management Interface (1303) and Allocation Management Interface (1304)), a centralized data repository ("ICE DB") (1305), and a LESO interface ("Resource Manager") (1306) to the IME. The IME is the heart of the ICE Management System, and the IME Kernel is the heart of the IME. The IME (1301) reviews and disposes of (either by approval or rejection) allocation requests received from Connection Managers (described below), generates ECCs to implement approved REQs,

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validates EACs before releasing resources, and interacts with LESO personnel through the Resource Manager (1306). The various types of request messages sent from a Connection Manager to the IME are generically called a "REQ." Through the LES Management Interface ("LES Mgmt I/F") (1303), the IME Kernel (1302) controls the LES Equipment Controller ("LEQC") (1307). The LEQC in turns controls the ICE Channel Units (1308) at a given LES. The LEQC also interacts with the LES Event Manager ("LEVM") (1309), which records usage of ICE Channel Units in "Log Files". An ICE Statistical Engine ("ICE Stats Engine") associated with the LEVM (1309) prepares usage reports and statistical reports based on the Log Files. The reports are stored in a statistical reports database ("Stats DB"). Periodically, the Log Files and reports are processed by the Key and Reporting Engine (1310) and collected by the ICTI Server or the Master Licensor. The LEQC (1307) controls the ICE Channel Units (1308) in response to commands from the IME Kernel (1302), monitors status of the ICE Channel Units, and forwards ICE Channel Unit usage data (e.g., session start time, stop time, and data rate) to the LEVM (1309). The LES Management Interface (1303) translates ICE M&C messages into M&C message-messages used by a given LEQC (1307), and therefore enables a standardized IME Kernel to communicate with LEQCs tailored to a given LES environment. A large LES may have many ICE Channel Units. To off-load from the IME the routine message traffic related to ICE Channel Unit status and usage, the LEQC, LEVM, Log Files, ICE Stats Engine, and Stats DB are typically distributed to one or more server computers other than the LES Server host. The "Connection Manager" ("CM") software component (1311, 1312, 1313) is the human interface software used by a LESO customer (or by LESO personnel on behalf of a LESO customer) to manage the resources allocated to that LESO or LESO customer. A Connection Manager can be tailored to a given LESO or LESO customer. The Allocation Management Interface (1304) translates ICE M&C messages into M&C message used by a given Connection Manager, and enables a standardized IME Kernel to communicate with Connection Managers tailored to various LESO customer environments. The IME Kernel can use various network management methodologies, including the methodology described in the patent application entitled, "CAPACITY ALLOCATION SYSTEM USING SEMI-AUTONOMOUS NETWORK ELEMENTS TO IMPLEMENT AND CONTROL A TRANSMISSION SCHEDULE", PCT Application Number WO1999US01317 19990122, Publication date 1999-07-29, commonly assigned with this application to Innovative Communications Technology, Inc. In an alternative

embodiment, the IME Kernel can be written as processes in the database management system that manages the ICE DB.

[92] The Resource Manager ("RM") (1306) is used by LESO personnel to configure and control the LES portion of the ICE Management System, LES resources, space segment, and earth segment used for ICE Services. The RM (1306) enables LESO personnel to define bulk space segment (e.g., transponder capacity leased from Inmarsat), to allocate bulk space segment to customer accounts (e.g., transponder bandwidth allocations, carrier center frequency allocations), to define (i.e., authorize and activate) ICE-enabled ~~Terminal~~ Terminals, to define ICE Channel Units, and to define LES backhaul ports, switching, and transport (terrestrial network facilities). Resources are classified as either dedicated (available for use by a single LESO customer) or group (available for use by all LESO customers, or a specific subset of customers). The RM includes a capability for managing more than one ICE-enabled Terminal time sharing, one ICE-enabled Terminal at a time, a common bandwidth allocation, an ICE Channel Unit, and backhaul resources, based on the receipt of REQs from a CM. A LESO customer does not necessarily have access to the current configuration of resources adjacent to the transponder bandwidth currently allocated to that customer. After receiving a REQ, the IME Kernel (1302) performs checks, using the data stored in the ICE DB (1305), to verify that other LESO customers and/or Inmarsat users will not be adversely impacted by implementing a REQ.

[93] The ICE Management Gateway ("IMG") software application (1314, 1315) comprises an IMG Kernel (1316), one or more "ICE Management Gateway Interfaces (1317)," one or more "Terminal Interfaces (1318)," and is associated with one or more Connection Managers. The IMG Kernel (1316) is principally devoted to routing interprocess messages ("IPMs") and uses addressing, routing, and acknowledgement methods known in the art. IMGs performs all IPM routing between the IME (1301) and, through the IMG (1315) on the LES Server, the Connection Managers (1311, 1312, 1313) used by or for a LESO's customers. The originating software process of an IPM sends the IPM to the ICE Management Gateway with which it has an ICE M&C channel and the ICE Management Gateway routes the IPM towards the IPMs destination. The ICE Management Gateway Interface ("IMG I/F") (1317) sends and receives IPMs from one IMG to another IMG. A "Terminal Interface" ("Term. I/F") (1318) sends and receives IPMs (ECCs, EACs, and other messages) between an IMG and a given ICE-enabled

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Terminal (1320) when a real-time, interactive ICE M&C channel (e.g., full period frame relay, dialed-up async, etc.) is available. The Connection Manager ("CM" or "Conn. Mgr") manages the resources allocated to a given LESO customer (e.g., add, delete, or otherwise change a given traffic path) by submitting REQs and other messages to the IME. If a REQ from ~~an~~ a CM (1312) is approved by the IME (1301), the IME replies to the IMG (1314) associated with the CM (1312) with an IPM that includes an ECC. The IMG Kernel (1316) uses that IPM to update the status of the REQ in the "Configuration Database" ("Config. DB") (1319) associated with the IMG (1314), and if a real-time, interactive M&C channel is available, delivers the ECC to the ICE-enabled Terminal (1320) identified in the REQ through a Terminal I/F (1318). When an EAC is received from the ICE-enabled Terminal (1320) through the Terminal I/F (1318), the IMG (1314) includes the EAC in an IPM to the IME (1301), and also updates the Config. DB (1319) with status. If the EAC is timely received by the IME, the IME (1301) sends to the IMG (1314) an IPM stating that resources will be released as requested in the relevant REQ, and the IMG Kernel (1316) updates the Config. DB (1319) with status of the REQ. In addition to information on pending REQs, the Config. DB (1319) contains information on active traffic paths. This information is accessible to a CM (1312, 1313) associated with the same IMG (1314) as the Config. DB (1319). The CM can periodically send IPMs to poll the IME to confirm active configurations involving the resources allocated to a LESO customer and obtain notices concerning traffic path conditions (e.g., warnings, path and device failures). The IME Kernel (1302) can also initiate IPMs to update Config. DBs at IMGs with information about active configurations and traffic path conditions.

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[97] As shown in FIG. 14, for each remote Inmarsat-B ICE MES Retrofit, there is a counterpart ICE Channel Unit allocated from a pool of ICE Channel Units (1401) providing satellite communications services to the remote Inmarsat-B ICE MES Retrofit. Inmarsat-B services use C-band paths between an LES and an Inmarsat satellite (including both operational and lease satellites), and L-band paths between an Inmarsat satellite and an MES. The ICE Channel Unit used with Inmarsat-B ICE MES Retrofits comprises an Inmarsat compliant, programmable satellite modem with 70 MHz intermediate frequency ("IF") and internal microcontroller, an M&C interface, and the ability to be configured through the M&C interface by exchange of ICE M&C messages with an ICE Server. The ICE Channel Unit normally used is an EFDData SDM-300A ("EFDData 300A"), which supports various modulation methods, FEC rates, and Reed-

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Solomon error correction. The EFData 300A modem is manufactured by Comtech EFData, 2114 West 7th Street, Tempe, Arizona 85281 (www.efdata.com”) and has a 70 MHz IF transmit/receive interface. A transmit port interfaces with an upconverter, and a receive port interfaces with a downconverter, in a manner known in the art. Use of upconverters and downconverters provide the C-band interface required by an HPA (transmit path) and LNA (receive path) at an LES. From the remote control I/O port (1402) of an ICE Channel Unit (1403), ICE M&C messages are routed via an ICE M&C channel (1404) that interconnects the ICE Channel Unit (1403) and the LES Equipment Controller (1405) on the LES Server (1406) for that LES. Encryption is not normally applied to ICE M&C messages exchanged between an ICE Server and a ICE Channel Unit. To configure and manage ICE Services, the ICE Server exchanges ICE M&C messages with the ICE Channel Unit and with the Embedded DSP in each Inmarsat-B ICE MES Retrofit with which the ICE Channel Unit shares a traffic path. The M&C channel between the ICE Channel Unit and the ICE Server uses a real-time interactive path. In the event of a failure of a given ICE Server, the ICE management duties of the failed ICE Server are assumed by a redundant ICE Server at the same LES or by a redundant ICE Server at a different LES. The ICE M&C channel to a given MES Embedded DSP may be a standalone, non-real-time M&C channel, so an ICE Server does not necessarily exchange messages directly with an Embedded DSP. If an ICE M&C channel is available on a real-time, interactive path between a LES Server and an Embedded DSP via a NOC Server, the LES Server and Embedded DSP can exchange M&C messages via the NOC Server. Although a user of ICE Services may own Inmarsat-B ICE MES Retrofits (or other ICE MES embodiments discussed below), a user is normally not permitted to directly control equipment that is used for ICE Services at an MES or LES.

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[98] The packaging and user interfaces of the components of an ICE Channel Unit for Inmarsat-B ICE Services differ from the packaging and user interfaces of an ICE-enabled Terminal since trained operators, rather than users, are responsible for the equipment at an LES. Whereas a ship may only have a single MES, an LES may serve hundreds or thousands of MESs and have its Inmarsat-B electronics in a dense packaging form, such as rack-mounted chassis, each chassis having a circuit boards that ~~serves~~ serve a series of MESs. Packaging of the components of an Inmarsat-B ICE ~~LES~~ Channel Unit is normally in a similarly dense packaging form, such

as rack-mounted chassis. The DSP Board used in an Inmarsat-B ICE MES Retrofit is not required in an ICE Channel Unit since transmit and receive paths, DC power, and M&C channels are not diplexed onto a single RF path at an LES. Instead, IF combiners and amplifiers, if needed, are used to frequency multiplex multiple transmit carriers onto a single transmit path which is connected to one or more upconverters and then to an HPA. In the receive path, LNA output is fed to one or more downconverters, which then feed dividers and amplifiers, if needed, to provide multiple receive paths to the receive port of a given ICE Channel Unit. The LES connects Inmarsat-B MES users (including users of Inmarsat-B ICE MES Retrofits) to terrestrial network nodes using backhaul traffic paths (1407). The LES can also interconnect such users to other MES users (including users of Inmarsat-B ICE MES Retrofits) served by that LES, for instance, for ship-to-ship dial-up calls or ship-to-ship leased slot services. In a given leased slot, the transmitter for the forward carrier (shore-to-ship) at the LES and the receiver for the forward carrier at the Inmarsat-B ICE MES Retrofit are configured for the same combination of FEC and Reed Solomon ("RS") error correction. Similarly for the return carrier (ship-to-shore), the transmitter at an Inmarsat-B ICE MES Retrofit and the receiver at the LES are configured for the same combination of FEC and RS. For Standard Services, the forward and return carriers are configured to occupy the same bandwidth and operate at the same data rate. However, this one-for-one relationship between the forward and return carriers is not a requirement for ICE Services and differing data rates and/or FEC and RS configuration options may be used to meet the requirements of the application. For instance, a user may use asymmetric ICE Services in which two or more Inmarsat-B ICE MES Retrofits share given leased bandwidth (one or more slots), and the transmit and receive data rates and bandwidths are different for the forward and return carriers.

[99] As shown in FIG. 15, a second preferred embodiment of the ICE invention uses a single ICE Modem (1501) to provide both ICE and standard MES functionality ("Integrated ICE MES"). An Integrated ICE MES (1502) that complies with Inmarsat-B specifications ("Inmarsat-B ICE MES") will be used to illustrate this embodiment. An Inmarsat-B ICE MES can replace an existing Inmarsat-B MES or be used for a new installation. In the Inmarsat-B ICE MES, the diplexer/switch is not needed. All other components and paths on the DSP Board are retained in the Inmarsat-B ICE MES except for the diplexers, entry switch, exit switch, and the paths and peripheral devices (e.g., dividers, combiners, low pass filter) associated with inserting the

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diplexers into the RF path on the DSP Board. All standard Inmarsat-B MES components other than a standard modem are contained in an Inmarsat-B ICE MES. The ICE Modem in an Inmarsat-B ICE MES is programmable and can function both in Standard Services mode and in ICE mode. The embedded computer ("Embedded ICE MES DSP") and control paths in the Inmarsat-B ICE MES replace the MCU microcontroller and control paths in a standard Inmarsat-B MES. In addition to the ICE Services instruction and data set, the instruction and data set of the Local ICE Management Program of the Inmarsat-B ICE MES includes the instructions and data required to provide Inmarsat-B Standard Services. Using the telephone, fax port, MCU functionality included in the ICE Modem and Embedded ICE MES DSP, the Inmarsat-B ICE MES can send and receive standard voice, fax, and data dial-up calls using an operational satellite, provide HSD in a leased slot, or provide ICE Services a leased slot. Dial-up calling requires a real-time exchange of control messages (e.g., signaling and supervision messages) between the Inmarsat-B ICE MES and an Inmarsat NCS or standalone ACSE to set-up calls and between the Inmarsat B ICE MES and an LES ACSE to tear down calls. Optionally, once a dial-up data call is established using standard Inmarsat-B call set-up procedures over an operational satellite, calls between an Inmarsat-B ICE MES and an LES can either stay in standard Inmarsat-B modes or switch to ICE Services, i.e., higher data rates for a given bandwidth compared with standard data rates.

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[103] ICE Channel Units are used at the LES to provide ICE Services to Inmarsat-B ICE MESs. The ICE Channel Units shown in FIG. 16 have the same M&C paths and channels as those shown in FIG. 14. ICE Channel Units can be configured through the M&C interface on the ICE Channel Unit to work as the LES node in satellite communications paths to Inmarsat-B ICE MES Retrofits, to Inmarsat-B ICE MESs, and optionally, to standard Inmarsat-B MESs. An ICE ACSE (1601) would normally not allocate ~~a~~an ICE Channel Unit capable of ICE Services for use in a traffic path where a standard modem can be used. Analogous to the implementation of ICE Services for leased slot operations, higher data rates for dial-up calls are obtained by implementing combinations of forward error correction, Reed Solomon error correction or other error correction such as "Turbo FEC" in the ICE Modem at the Inmarsat-B ICE MES and in the ICE Channel Unit. In a given call or leased slot service, the same combination of forward error correction and Reed Solomon error correction or "Turbo FEC" is implemented at the Inmarsat-B

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ICE MES and at the ICE Channel Unit. Switching to ICE Services in a dial-up call or in a leased slot requires an exchange of ICE M&C messages among the ICE Server, the Embedded ICE MES DSPs, and the ICE Channel Unit involved in a given Inmarsat-B traffic path. At 64 kbps, Viterbi FEC concatenated with Reed-Solomon error correction introduces a delay of 0.5 seconds. At 128 kbps, Viterbi FEC concatenated with RS introduces about 0.25 seconds delay. If such delay is an issue, Reed Solomon error correction is not used. As an alternative, rate 3/4 Turbo FEC may be used, which provides the same 128 kbps data rate in the same 100 kHz bandwidth, but with no additional delay. Any backhaul circuits at the LES serving the Inmarsat-B ICE MES must be capable of handling the higher data rates provided by ICE Services. ICE Services can include encryption of traffic through optional processors described below, so that a standard call can become encrypted when switched to ICE Services.

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[104] When not engaged in a dial-up call, the Inmarsat-B ICE MES can provide standard HSD lease services or ICE services in a leased slot. Since the Inmarsat-B ICE MES has direct control of the HPA, and the HPA need not be the same as is used with the Saturn B MES, the Inmarsat B ICE MES can be designed around an HPA that does not require a constant envelope waveform, and ICE Services can use waveforms other than constant envelope without triggering an error condition that would require the HPA to be turned off. The Embedded ICE MES DSP controls all M&C and payload paths in an Inmarsat-B ICE MES, and can therefore introduce an optional real-time, interactive, in-band ESC ICE M&C channel into the traffic path between the Inmarsat-B ICE MES and the corresponding Inmarsat-B ICE ~~LES~~ Channel Unit. Alternatively, an optional real-time, interactive ICE M&C channel can be implemented through an external network path, as described below. The combination of the preferred method of "NCS spoofing", as described above, of the NCS M&C messages and channels by a modified ICE ACSE and the standalone ICE M&C channel design enables standalone operation in the absence of an real-time, interactive ICE M&C channel. If available, the ESC (or other ICE M&C channel) can be used to exchange all types of ICE M&C messages, as described above, including messages for real-time power level adjustments and changes in modulation method, FEC, Reed-Solomon error correction, encryption, etc.

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[105] As shown in FIG. 17, a third preferred embodiment of the ICE invention couples two ICE retrofit embodiments (1701, 1702) in a redundant configuration for Inmarsat-B service. A redundant configuration is desirable to counteract interruptions due to ~~for~~ antenna blockages or equipment failures. In some installations of RF terminals on ships, depending on the orientation of a ship in relationship to an orbital satellite providing service to the RF terminal, the superstructure of a ship or other obstruction can interrupt a transmission between the satellite and an MES. In this third preferred embodiment, the same baseband input and output signals (1703) are supplied to an A/B switch (1704), which in turn provides the baseband signals to one of a pair of two Inmarsat-B ICE MES Retrofits. Only one of the pair provides ICE Services and receives baseband input at a given time. The Embedded DSP in a first Inmarsat-B ICE Retrofit in the pair communicates with the other Embedded DSP in the pair over an async ICE M&C path (1705) through a port of the UART in each Embedded DSP to compare received signal strength data. Each Embedded DSP also communicates with the A/B Switch (1704) over a separate async ICE M&C path (1706, 1707) using a port of the UART in such Embedded DSP to control switching by the A/B Switch (1704). The ICE Modem provides received signal strength data to the Embedded DSP controlling it. The instruction and data set of the Local ICE Management Program is expanded to include the instructions and data required to determine which of the two Inmarsat-B ICE Retrofits is receiving the stronger signal from the lease satellite providing service, and if the received signal strength at one of the Inmarsat-B ICE Retrofits in the pair exceeds the received signal strength at the other Inmarsat-B ICE MES Retrofit in the pair by a selectable threshold amount, and if the Inmarsat-B ICE MES Retrofit with the weaker received signal strength is active (i.e., in ICE ON mode) in providing connectivity to the LES, the Local ICE Management Program switches the Inmarsat-B ICE MES Retrofit with the stronger received signal strength into ICE ON mode (i.e., it becomes the active one of the pair providing connectivity to the LES) and switches the Inmarsat-B ICE MES Retrofit with the weaker received signal strength into ICE OFF mode. The Local ICE Management Program making the off-line Inmarsat-B ICE MES Retrofit the active terminal in a redundant pair of Inmarsat-B ICE MES Retrofit ("Handover") also occurs as a result of detection by the Local ICE Management Program of fault conditions in the on-line Inmarsat-B MES Retrofit. Fault conditions that would trigger Handover include a loss of demodulated signal, component failure, or differentially and rapidly deteriorating signal quality in the on-line Inmarsat-B ICE MES Retrofit versus the off-line Inmarsat-B ICE MES Retrofit.

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[107] As shown in FIG. 18, a fourth preferred embodiment of the ICE invention couples two Integrated ICE MESs (including without limitation Inmarsat-B ICE MESs) in a redundant configuration in the same way as in the third preferred embodiment. In this fourth preferred embodiment, the same baseband input and output signals are supplied to a pair of two Integrated ICE MESs (1801, 1802). Management, control, and operation of the configuration in FIG. 18 is the same as in FIG. 17. Only one of the pair provides ICE Services or ~~standard services~~ **Standard Services** at a given time. The Embedded ICE MES DSP in a first Integrated ICE MES in the pair communicates with the other Embedded ICE MES DSP in the pair through a port of the UART in each Embedded ICE MES DSP. The ICE Modem provides received signal strength data to the Embedded ICE MES DSP controlling it. The instruction and data set of the Local ICE Management Program is expanded to include the instructions and data required to determine which of the two Integrated ICE MESs is receiving the stronger signal from the lease or operational satellite providing service, and if the received signal strength at a first Integrated ICE MES in a pair exceeds the received signal strength at the other Integrated ICE MES in the pair by a selectable threshold amount, and the Integrated ICE MES with the weaker received signal strength is active (i.e., in ICE ON mode) in providing connectivity to the LES, the Local ICE Management Program switches the Integrated ICE MES with the stronger received signal strength into ICE ON mode (i.e., it becomes the active one of the pair providing connectivity to the LES) and switches the Integrated ICE MES with the weaker received signal strength into ICE OFF mode. The Local ICE Management Program making the off-line Integrated ICE MES the active remote terminal in a redundant pair of Integrated ICE MESs ("Handover") also occurs as a result of detection by the Local ICE Management Program of fault conditions in the on-line Integrated ICE MES. Fault conditions that would trigger Handover include a loss of demodulated signal, component failure, or differentially and rapidly deteriorating signal quality in the on-line Integrated ICE MES versus the off-line Integrated ICE MES. As in the configuration illustrated in FIG. 17, the PBX can provide real-time, interactive ICE M&C channels (1803, 1804) to the Inmarsat-B ICE MESs (using a dial modem attached to a voice card on the PBX).

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[110] As shown in FIG. 20, other ICE embodiments based on the Inmarsat-B ICE MES Retrofit can be used to retrofit earth stations used for services other than the C-band forward path/L-band

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return path used by Inmarsat-B. Most hub earth stations, such as LESSs, use satellite modems with a uniform 70 MHz IF interfaces (in some cases, other IF frequencies, such as 140 MHz, are used) (2001). Converting transmit and receive paths between IF frequencies and uplink/downlink frequencies ("Satlink Frequencies") at hub earth stations works as described above in the discussion of the IF frequency to C-band Satlink Frequencies conversions associated with the ICE Channel Unit, except the Satlink Frequencies in these other ICE embodiments are a band other than C-band (e.g., Ku-band, Ka-band). ICE embodiments in remote terminals can also use upconverters and downconverters under the control of the ICE Management System to provide Satlink Frequencies other than the L-band return path used by Inmarsat-B MESSs. In such retrofit ICE embodiments, upconverters and downconverters (2002, 2003, 2004) are inserted between the transmit port and receive port, respectively, of the second diplexer and the ICE Modem on the DSP Board. One or more upconverters convert the IF frequency of the transmit output of the ICE Modem to the uplink Satlink Frequency. One or more downconverters convert the downlink Satlink Frequency to the IF frequency of the receive input of the ICE Modem in a manner known in the art. For instance, in a retrofit embodiment for a Ku-band earth station, an ICE Modem with a 70 MHz band intermediate frequencies would be equipped with upconverters to match the 14 GHz uplink band, and downconverters to match the 12 GHz downlink band (~~2003~~-(2003)). The ICE Management System, including the ICE Server and the Embedded DSP in each ICE remote terminal embodiment, would operate in the manner described for the Inmarsat-B ICE MES Retrofit and Inmarsat-B ICE MES described above, and also manage and control the upconverters and downconverters used in a given embodiment. In these ICE embodiments, instructions and parameters specific to upconverters and downconverters are included in ICE M&C messages, or by embedding logic in the Local ICE Management Program running on the Embedded DSP on the DSP Board. Other than the upconversion and downconversion between IF and Satlink Frequencies, a remote terminal ICE embodiment based on the Inmarsat-B ICE MES Retrofit operates the same as an Inmarsat-B ICE MES Retrofit. The use of the ICE Management System, particularly ECCs, disabling local user control of critical modem parameters, standalone M&C channels, and optional real-time M&C channels, is as novel in non-Inmarsat satellite services as it is in Inmarsat satellite services.

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[113] In embodiments of the ICE invention equipped with a real-time, interactive M&C control path, such as an ICE ESC channel used by an Integrated ICE MES, or ICE M&C channel via a

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Packet M&C Device used by an Inmarsat-B ICE MES Retrofit, the ICE Management System can set transmit power and measure the resultant performance, then adjust transmit power to compensate for the remote terminal's location within the satellite footprint and minor pointing errors. Standard Services only perform power level adjustment between a hub earth station and a remote terminal during call set up negotiations. In ICE Services, power level adjustment is performed as part of call set up and can be performed periodically during the call or lease period. The procedure of power level adjustment between a hub earth station and a remote terminal is known in the art and typically measures the path performance in terms of bit error rate, carrier/noise, Eb/No, or some other quality factor, and then adjusts power, data rate, error correction, and/or modulation method to achieve the highest performance at the lowest power/bandwidth cost. These embodiments of the ICE invention equipped with a real-time M&C channel can also include dynamic selection of modulation method, dynamic allocation of carrier center frequencies and bandwidth, and dynamic ~~and~~ selection of error correction methods. Such dynamic selection and allocation is known in the art and is managed and controlled by the ICE Management System through an exchange of ICE M&C messages between the ICE Server and embodiments of the ICE invention equipped with a real-time M&C channel.